

WHAT IS CLAIMED IS:

1. A three dimensional modeling apparatus for generating three dimensional shape data of a three dimensional object,
5 comprising:

projection means for projecting pattern light onto said three dimensional object;

image input means for inputting an image of said three dimensional object;

10 rough shape calculation means for calculating a rough shape from said image;

detailed shape calculation means for calculating a detailed shape from said image; and

15 three dimensional shape data generating means for generating three dimensional shape data of said three dimensional object based on said rough shape and said detailed shape.

2. A three dimensional modeling apparatus for generating three dimensional shape data of a three dimensional object,
20 comprising:

projection means for projecting pattern light onto said three dimensional object;

image input means for inputting an image of said three dimensional object;

25 rough shape input means for inputting a rough shape of said three dimensional object;

detailed shape calculation means for calculating a detailed

shape from said image; and

three dimensional shape data generating means for generating three dimensional shape data of said three dimensional object based on said rough shape and said detailed shape.

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3. A three dimensional modeling apparatus for generating three dimensional shape data of a three dimensional object, comprising:

image input means for inputting an image of said three dimensional object, said image being obtained by projecting pattern light onto said three dimensional object;

rough shape calculation means for calculating a rough shape from said image;

detailed shape calculation means for calculating a detailed shape from said image; and

three dimensional shape data generating means for generating three dimensional shape data of said three dimensional object based on said rough shape and said detailed shape.

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4. A three dimensional modeling apparatus for generating three dimensional shape data of a three dimensional object, comprising:

image input means for inputting an image of said three dimensional object, said image being obtained by projecting pattern light onto said three dimensional object;

rough shape input means for inputting a rough shape of said three dimensional object;

detailed shape calculation means for calculating a detailed shape from said image; and

three dimensional shape data generating means for generating three dimensional shape data of said three dimensional object based
5 on said rough shape and said detailed shape.

5. A three dimensional modeling apparatus according to claim 1,

wherein said three dimensional shape data generating means
10 determines the final three dimensional shape data based on the following rule; if the detailed shape exists inside the rough shape, then the detailed shape is the final three dimensional shape data of said object, otherwise the rough shape is taken as the final three dimensional shape data of said object.

15 6. A three dimensional modeling apparatus according to claim 1,

wherein said three dimensional shape data generating means obtains a region where the object surface can exist based on the
20 rough shape, to generate three dimensional shape data of said three dimensional object based on the rough shape, the detailed shape, and the region where the object surface can exist.

25 7. A three dimensional modeling apparatus according to claim 1,

wherein said detailed shape calculation means obtains a plurality of object surface location candidates from the input

image.

8. A three dimensional modeling apparatus according to claim 1,

5 wherein said detailed shape calculation means sets a region where the object surface cannot exist in a portion inside the rough shape and determines a region inside the rough shape other than said region where the object surface cannot exist as a region where the object surface can exist, to generate three dimensional shape data of said three dimensional object based on the rough shape, the detailed shape, and the region where the object surface can exist.

9. A three dimensional modeling apparatus according to claim 1,

15 wherein said three dimensional shape data generating means determines a final object surface location candidate from a plurality of object surface location candidates based on a region where the object surface can exist and generates three dimensional shape data of said three dimensional object based on said final object surface location candidate.

10. A three dimensional modeling apparatus according to claim 1,

25 wherein the rough shape is calculated by said rough shape calculation means based on silhouette information obtained from the object image input by said image input means.

11. A three dimensional shape data recording apparatus for recording three dimensional shape data of a three dimensional object, comprising:

three dimensional shape data generation means for generating
5 three dimensional shape data of said three dimensional object;

three dimensional shape data reliability assigning means for assigning a data reliability evaluation value to each of said three dimensional shape data; and

three dimensional shape data recording means for recording
10 three dimensional shape data to which said reliability evaluation value is assigned in a medium.

12. A three dimensional shape data recording apparatus for recording three dimensional shape data of a three dimensional
15 object, comprising:

three dimensional shape data capturing means for capturing three dimensional shape data of said three dimensional object;

three dimensional shape data reliability assigning means for assigning a data reliability evaluation value to each of said three
20 dimensional shape data; and

three dimensional shape data recording means for recording three dimensional shape data to which said reliability evaluation value is assigned in a medium.

25 13. A three dimensional modeling method for generating three dimensional shape data of a three dimensional object, comprising the steps of:

projecting pattern light onto said three dimensional object;
inputting an image of said three dimensional object;
calculating a rough shape from said image;
calculating a detailed shape from said image; and

5 generating three dimensional shape data of said three
dimensional object based on said rough shape and said detailed
shape.

14. A three dimensional modeling method for generating three
10 dimensional shape data of a three dimensional object, comprising
the steps of:

projecting pattern light onto said three dimensional object;
inputting an image of said three dimensional object;
capturing a rough shape of said three dimensional object;
15 calculating a detailed shape from said image; and

generating three dimensional shape data of said three
dimensional object based on said rough shape and said detailed
shape.

20 15. A three dimensional modeling method for generating three
dimensional shape data of a three dimensional object, comprising
the steps of:

inputting an image of said three dimensional object, said
image being obtained by projecting pattern light onto said three
25 dimensional object;

calculating a rough shape from said image;
calculating a detailed shape from said image; and

generating three dimensional shape data of said three dimensional object based on said rough shape and said detailed shape.

5 16. A three dimensional modeling method for generating three dimensional shape data of a three dimensional object, comprising the steps of:

10 inputting an image of said three dimensional object, said image being obtained by projecting pattern light onto said three dimensional object;

 capturing a rough shape of said three dimensional object;
 calculating a detailed shape from said image; and

15 generating three dimensional shape data of said three dimensional object based on said rough shape and said detailed shape.

17. A three dimensional modeling method according to claim 13,

20 wherein said step of generating three dimensional shape data includes determining the final three dimensional shape data based on the following rule; if the detailed shape exists inside the rough shape, then the detailed shape is the final three dimensional shape data of said object, otherwise the rough shape is taken as the final three dimensional shape data of said object.

25 18. A three dimensional modeling method according to claim 13,

wherein said step of generating three dimensional shape data includes obtaining a region where the object surface can exist based on the rough shape, to generate three dimensional shape data of said three dimensional object based on the rough shape, the detailed shape, and the region where the object surface can exist.

19. A three dimensional modeling method according to claim 13,

wherein said step of calculating detailed shape includes obtaining a plurality of object surface location candidates from the input image.

20. A three dimensional modeling method according to claim 13,

wherein said step of calculating detailed shape includes setting a region where the object surface cannot exist in a portion inside the rough shape and determining a region inside the rough shape other than said region where the object surface cannot exist as a region where the object surface can exist, to generate three dimensional shape data of said three dimensional object based on the rough shape, the detailed shape, and the region where the object surface can exist.

21. A three dimensional modeling method according to claim 13,

wherein said step of generating three dimensional shape data includes determining a final object surface location candidate

from a plurality of object surface location candidates based on a region where the object surface can exist and generating three dimensional shape data of said three dimensional object based on said final object surface location candidate.

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22. A three dimensional modeling method according to claim 13,

wherein the rough shape is calculated by said rough shape calculation means based on silhouette information obtained from the object image input by said step of inputting an image.

23. A three dimensional shape data recording method for recording three dimensional shape data of a three dimensional object, comprising the steps of:

generating three dimensional shape data of said three dimensional object;

assigning a data reliability evaluation value to each of said three dimensional shape data; and

recording three dimensional shape data to which said reliability evaluation value is assigned in a medium.

24. A three dimensional shape data recording method for recording three dimensional shape data of a three dimensional object, comprising the steps of:

capturing three dimensional shape data of said three dimensional object;

assigning a data reliability evaluation value to each of said

three dimensional shape data; and

recording three dimensional shape data to which said reliability evaluation value is assigned in a medium.

5 25. A medium having a program recorded therein for causing a computer to generate three dimensional shape data of a three dimensional object, said program comprising the steps of:

10 controlling pattern light projection section connected to said computer for projecting pattern light onto said three dimensional object;

inputting an image of said three dimensional object;

calculating a rough shape from said image;

calculating a detailed shape from said image; and

15 generating three dimensional shape data of said three dimensional object based on said rough shape and said detailed shape.

20 26. A medium having a program recorded therein for causing a computer to generate three dimensional shape data of a three dimensional object, said program comprising the steps of:

controlling a pattern light projection section connected to said computer for projecting pattern light onto said three dimensional object;

inputting an image of said three dimensional object;

25 capturing a rough shape of said three dimensional object;

calculating a detailed shape from said image; and

generating three dimensional shape data of said three

dimensional object based on said rough shape and said detailed shape.

27. A medium having a program recorded therein for causing
5 a computer to generate three dimensional shape data of a three dimensional object, said program comprising the steps of:

inputting an image of said three dimensional object, which is obtained by projecting pattern light onto said three dimensional object;

10 calculating a rough shape from said image;
calculating a detailed shape from said image; and
generating three dimensional shape data of said three dimensional object based on said rough shape and said detailed shape.

28. A medium having a program recorded therein for causing
15 a computer to generate three dimensional shape data of a three dimensional object, said program comprising the steps of:

inputting an image of said three dimensional object, which
20 is obtained by projecting pattern light onto said three dimensional object;

capturing a rough shape of said three dimensional object;
calculating a detailed shape from said image; and

generating three dimensional shape data of said three
25 dimensional object based on said rough shape and said detailed shape.

29. A medium having a three dimensional modeling program recorded therein according to claim 25,

wherein said step of generating three dimensional shape data includes determining the final three dimensional shape data based on the following rule; if the detailed shape exists inside the rough shape, then the detailed shape is the final three dimensional shape data of said object, otherwise the rough shape is taken as the final three dimensional shape data of said object.

30. A medium having a three dimensional modeling program recorded therein according to claim 25,

wherein said step of generating three dimensional shape data includes obtaining a region where the object surface can exist based on the rough shape, to generate three dimensional shape data of said three dimensional object based on the rough shape, the detailed shape, and the region where the object surface can exist.

31. A medium having a three dimensional modeling program recorded therein according to claim 25,

wherein said step of calculating a detailed shape includes obtaining a plurality of object surface location candidates from the input image.

32. A medium having a three dimensional modeling program recorded therein according to claim 25,

wherein said step of calculating a detailed shape includes setting a region where the object surface cannot exist in a portion

inside the rough shape and determining a region inside the rough shape other than said region where the object surface cannot exist as a region where the object surface can exist, to generate three dimensional shape data of said three dimensional object based on
5 the rough shape, the detailed shape, and the region where the object surface can exist.

33. A medium having a three dimensional modeling program recorded therein according to claim 25,

10 wherein said step of generating three dimensional shape data includes determining a final object surface location candidate from a plurality of object surface location candidates based on a region where the object surface can exist and generating three dimensional shape data of said three dimensional object based on
15 said final object surface location candidate.

34. A medium having a three dimensional modeling program recorded therein according to claim 25,

20 wherein the rough shape is calculated by said step of calculating a rough shape based on silhouette information obtained from the object image input by said step of inputting an image.

35. A medium having a program recorded therein for causing a computer to record three dimensional shape data of a three
25 dimensional object in the medium, said program comprising the steps of:

generating three dimensional shape data of said three

dimensional object;

assigning a data reliability evaluation value to each of said three dimensional shape data; and

recording three dimensional shape data to which said
5 reliability evaluation value is assigned in the medium.

36. A medium having a program recorded therein for causing a computer to record three dimensional shape data of a three dimensional object in the medium, said program comprising the steps

10 of:

capturing three dimensional shape data of said three dimensional object;

assigning a data reliability evaluation value to each of said three dimensional shape data; and

15 recording three dimensional shape data to which said reliability evaluation value is assigned in the medium.

37. A medium having three dimensional shape data of a three dimensional object recorded therein, said medium holding data
20 reliability evaluation value information for each of said three dimensional shape data.

38. A three dimensional modeling apparatus for generating three dimensional shape data of a three dimensional object,
25 comprising:

projection means for projecting pattern light onto said three dimensional object;

image input means for inputting an image of said three dimensional object; and

three dimensional shape calculation means for calculating a three dimensional shape of said three dimensional object from the
5 input image,

wherein said three dimensional shape calculation means extracts a pattern projected region and a pattern border region in said input image to calculate the three dimensional shape of said three dimensional object based on these regions.

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39. A three dimensional modeling apparatus according to claim 1,

wherein said detailed shape calculation means extracts a pattern projected region and a pattern border region in said input
15 image to calculate the detailed shape of said three dimensional object based on these regions.

40. A three dimensional modeling apparatus according to claim 38,

20 wherein said pattern light has a plurality of binary patterns.

41. A three dimensional modeling apparatus according to claim 38,

wherein said image input means performs image input from at
25 least two positions.

42. A three dimensional modeling apparatus for generating

three dimensional shape data of a three dimensional object,
comprising:

projection means for projecting pattern light onto said three
dimensional object;

5 image input means for inputting an image of said three
dimensional object; and

three dimensional shape calculation means for calculating a
three dimensional shape of said three dimensional object from the
input image,

10 wherein said image input means performs image input from at
least two positions,

said three dimensional shape calculation means extracts a
portion in said input image where color or density changes, and

15 matching of portions where color or density changes is
performed between input images, to calculate the three dimensional
shape of said three dimensional object.

43. A three dimensional modeling apparatus according to
claim 1,

20 wherein said image input means performs image input from at
least two points at different locations,

said detailed shape calculation means extracts a portion in
said input image where color or density changes, and

25 matching of portions where color or density changes is
performed between input images, to calculate the three dimensional
shape of said three dimensional object.

44. A three dimensional modeling apparatus according to claim 3,

wherein said image input means performs image input where the images are captured at least two different points at different locations,

said detailed shape calculation means extracts a portion in said input image where color or density changes, and

matching of portions where color or density changes is performed between input images, to calculate the three dimensional shape of said three dimensional object.

45. A three dimensional modeling apparatus according to claim 42,

wherein said pattern light for projection includes multi-color patterns in which adjacent patterns have different colors having a hue difference of at least 90 degree or more, or a brightness difference of 0.3 or more, when the colors are represented in an HSV space.

46. A three dimensional modeling apparatus according to claim 42,

wherein said matching of the portions where color or density changes is obtained based on properties of the portions where color or density changes, which are obtained from the input images.

47. A three dimensional modeling apparatus according to claim 46,

wherein the property of the portion where color or density changes is color information regarding portions located to the left and right of, or above and below, said portion where color or density changes in said input image.

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48. A three dimensional modeling apparatus according to claim 46,

wherein averaging is performed on the input images when said property is obtained.

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49. A three dimensional modeling apparatus according to claim 48,

wherein said averaging is performed for each of divided regions of the input image.

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50. A three dimensional modeling apparatus according to claim 1, further comprising moving means for moving said projection means and said image input means.

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51. A three dimensional modeling apparatus according to claim 50,

wherein said moving means moves said projection means and said image input means based on said rough shape.

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52. A three dimensional modeling apparatus for generating three dimensional shape data of a three dimensional object, comprising:

at least two three dimensional shape input means for obtaining
a three dimensional shape of said three dimensional object; and
moving means for moving said three dimensional shape input
means,

5 wherein said three dimensional shape input means have
different three dimensional input accuracy.

53. A three dimensional modeling apparatus according to
claim 52,

10 wherein said moving means moves said three dimensional shape
input means having higher three dimensional input accuracy based
on three dimensional shape information obtained by said three
dimensional shape input means having lower three dimensional input
accuracy.

15 54. A three dimensional modeling method for generating three
dimensional shape data of a three dimensional object, comprising
the steps of:

20 projecting pattern light onto said three dimensional object;
inputting an image of said three dimensional object; and
calculating a three dimensional shape of said three
dimensional object from the input image,

25 wherein said step of calculating the three dimensional shape
includes extracting a pattern projected region and a pattern border
region in said input image to calculate the three dimensional shape
of said three dimensional object based on these regions.

55. A three dimensional modeling method according to claim
13,

wherein said step of calculating the detailed shape includes
extracting a pattern projected region and a pattern border region
5 in said input image to calculate the detailed shape of said three
dimensional object based on these regions.

56. A three dimensional modeling method according to claim
54,

10 wherein said pattern light has a plurality of binary patterns.

57. A three dimensional modeling method according to claim
54,

15 wherein said step of inputting an image includes performing
image input from at least two positions.

58. A three dimensional modeling method for generating three
dimensional shape data of a three dimensional object, comprising
the steps of:

20 projecting pattern light onto said three dimensional object;
inputting an image of said three dimensional object; and
calculating a three dimensional shape of said three
dimensional object from the input image,

wherein said step of inputting an image includes performing
25 image input from at least two positions,

said step of calculating the three dimensional shape includes
extracting a portion in said input image where color or density

changes, and

matching portions where color or density changes between input images, to calculate the three dimensional shape of said three dimensional object.

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59. A three dimensional modeling method according to claim 13,

wherein said step of inputting an image includes performing image input where the images are captured at least two points at different locations,

said step of calculating a detailed shape includes extracting a portion in said input image where color or density change, and

matching portions where color or density changes between input images, to calculate the three dimensional shape of said three dimensional object.

60. A three dimensional modeling method according to claim 58,

wherein said pattern light for projection includes multi-color patterns in which adjacent patterns have different colors having a hue difference of at least 90 degrees or more, or a brightness difference of 0.3 or more, when the colors are represented in an HSV space.

61. A three dimensional modeling method according to claim 58,

wherein said matching of the portions where color or density

changes is obtained based on properties of the portions where color or density changes, which are obtained from the input image.

62. A three dimensional modeling method according to claim

5 61,

wherein the property of the portion where color or density changes is color information regarding portions located to the left and right of, or above and below, said portion where color or density changes in said input images.

63. A three dimensional modeling method according to claim

61,

wherein averaging is performed on the input images when said property is obtained.

64. A three dimensional modeling method according to claim

63,

wherein said averaging is performed for each of divided regions of the input images.

65. A three dimensional modeling method for generating three dimensional shape data of a three dimensional object, comprising:

at least two three-dimensional shape inputting steps of obtaining the three dimensional shape of said three dimensional object; and

a step of moving a three dimensional shape input section; wherein said three dimensional shape inputting steps have

different three dimensional input accuracy.

66. A three dimensional modeling apparatus for generating three dimensional shape data of a three dimensional object,
5 comprising:

first three dimensional shape measuring means for obtaining rough shape information of said three dimensional object;

second three dimensional shape measuring means for obtaining detailed shape information of said three dimensional object; and

10 a three dimensional shape data generating section for generating the three dimensional shape data of said three dimensional object based on said rough shape information and said detailed shape information.

15 67. A three dimensional modeling apparatus according to claim 66, further comprising control means for controlling the position of said second three dimensional shape measuring means, said control means being controlled based on said rough shape information obtained by said first three dimensional measuring
20 means.

68. A three dimensional modeling method for generating three dimensional shape data of a three dimensional object, comprising:

25 a first three dimensional shape measuring step of obtaining rough shape information of said three dimensional object;

a second three dimensional shape measuring step of obtaining detailed shape information of said three dimensional object; and

a three dimensional shape data generating step of generating the three dimensional shape data of said three dimensional object based on said rough shape information and said detailed shape information.

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69. A medium having a program recorded therein for causing a computer to generate three dimensional shape data of a three dimensional object, said program comprising:

a first three dimensional shape measuring step of obtaining rough shape information of said three dimensional object;

a second three dimensional shape measuring step of obtaining detailed shape information of said three dimensional object; and

a three dimensional shape data generating step of generating the three dimensional shape data of said three dimensional object based on said rough shape information and said detailed shape information.